



The Scarab-III Remotely Operated Vehicle

The Problem: As part of a Federal Facilities Agreement (FFA), the Department of Energy (DOE) Oak Ridge Operations is responsible for characterizing and closing a number of underground storage tanks. These tanks were once used for storing high- and low-level radioactive and mixed waste but have since been taken out of service. Samples from the contents of these tanks must be analyzed for contaminants to determine the final disposition of each tank and its contents. Access to many of these tanks is limited to small-diameter risers that allow for sample collection at only one discrete point below the opening. To collect a more representative sample without exposing workers to tank interiors, a remote-controlled retrieval method was required. Because many of the tanks have access penetrations that are 18 in. or less in diameter, have minimal headspace, and contain internal piping, a small-vehicle system was needed to deploy sampling and inspection tools in the tanks.

The Deployment: The Scarab-III Remotely Operated Vehicle System was successfully

A ROBOTICS SUCCESS: Sampling and Inspecting Tanks at the Oak Ridge National Laboratory

deployed in FFA Tank T-14 May 26–28, 1999, to collect sample materials throughout the tank. A thorough inspection of the tank interior was also completed during this time. These sampling and inspection activities paved the way for sludge removal and final in-place grouting of the tank that was completed in December 2000.

The Technology: The Scarab-III system was developed and manufactured by ROV Technologies, Inc., to the specifications provided by the Oak Ridge National Laboratory (ORNL) to provide the means for sampling and inspecting radioactive, underground storage tanks. Rugged design and sturdy construction make the system well suited for deployment into underground storage tanks.

The 125-lb vehicle is teleoperated, which means an operator in a remote location controls all movements without a preprogrammed routine. The vehicle is skid steered; that is, its speed and direction are controlled by a joystick that directs the motion of the wheels on either side of the chassis. The wheels may be replaced with tracks, if desired. The vehicle is also equipped with a manipulator capable of wrist rotation up to 360 degrees, elbow movement up or down 90 degrees, and a gripper opening to accommodate a 2-in.-diam object weighing up to 5 lb (for sampling).

The vehicle comes equipped with three cameras: two black-and-white, fixed-focus cameras mounted in the front and rear ends of the vehicle's housing and a color camera with 25X zoom mounted on top of a turret. The vehicle turret also provides the pan and tilt for the color camera. Lights are provided for each of the cameras.



The Scarab-III Deployment and Containment System

A glove box structure was built for contamination containment. This deployment and containment module (DCM) included winches to lower the vehicle into the tank and to retract it following deployment.

A second winch was available for positioning other tools in the tank. A spray wand was included in the DCM for decontamination of the vehicle. A pass-through port was also provided for passing samples out of the DCM or for passing tools in. The DCM could be lifted by a crane into position on a tank or placed by forklift. A 30-in. opening in the bottom of the DCM provided the interface to tank risers.

The Benefit. Implementation of this remote vehicle system provided a means of safely acquiring multiple samples from underground waste storage tanks. The sampling and inspection tasks completed with this vehicle system paved the way for retrieval and closure of this tank. This technology could be used in many other applications where a remotely operated mobile manipulation system is required and where the diameter of the access penetrations is 18-in. or larger. The DCM provided a multipurpose structure for containment,

deployment, decontamination, storage, and transportation of the vehicle system.

Future Advances Through Rbx Initiatives:

The remote vehicle system deployed initially in ORNL Tank T-14 enabled sampling throughout the tank. This system was, however, fairly simple in its operation and very limited in the lift capacity and dexterity of the on-board manipulator. One area that could benefit from more advanced technologies is greater dexterity and increased lift capacity. These improvements could be achieved through development of lightweight high-capacity joint actuators. Another area of potential advancement would be improved cable and tether management. Use of wireless controls for communications and wireless video transmission would eliminate most of the tether.

For more information on this project please contact:

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